



## **The combined effect of regulation and support in agriculture and energy sector related to biogas production**

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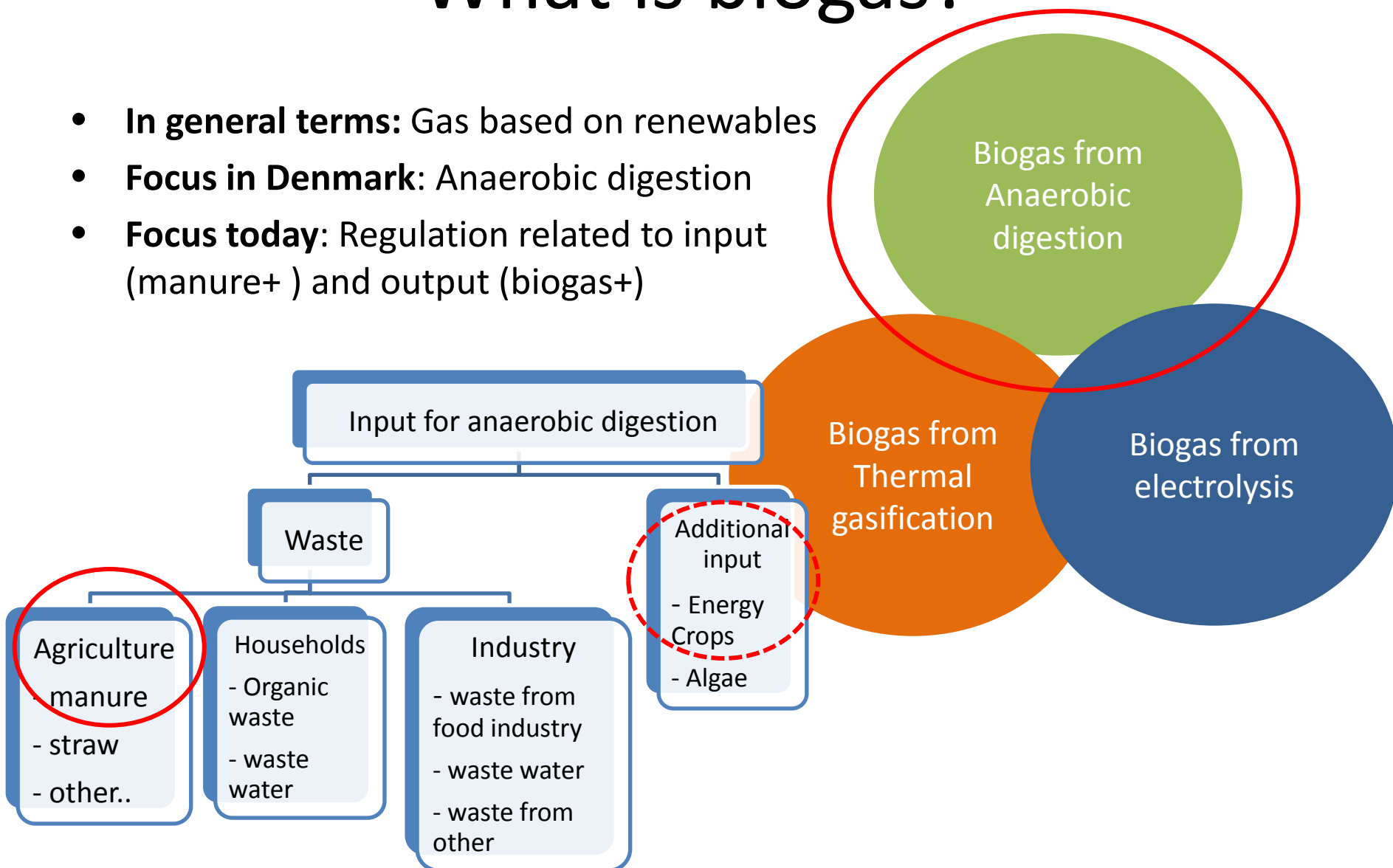


# SESSION: Innovation and Public Engagement THE COMBINED EFFECT OF REGULATION AND SUPPORT IN AGRICULTURE AND ENERGY SECTOR RELATED TO BIOGAS PRODUCTION

Lise Skovsgaard, Economist  
and Ph.d.-student at  
DTU Management Engineering,

# What is biogas?

- **In general terms:** Gas based on renewables
- **Focus in Denmark:** Anaerobic digestion
- **Focus today:** Regulation related to input (manure+ ) and output (biogas+)



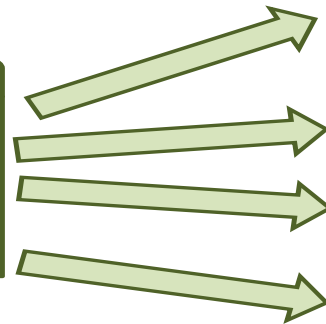
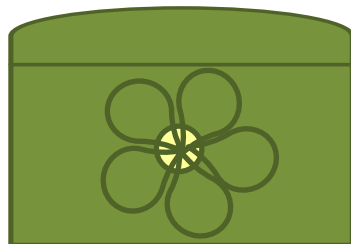
# Biogas is a part of the Danish goal as fossil free in 2050

Comparissons of scenarios 2050					
Energy input	Wind	Biomass	Bio+	Hydrogen	Fossil
Biomass	158 PJ	358 PJ	608 PJ	108 PJ	122 PJ
Wind	17500 MW	8500 MW	6000 MW	21000 MW	8500 MW
Solar cells	2000 PJ	1000 PJ	1000 PJ	2000 PJ	600 PJ
Hydrogen	For upgrade	None	None	For upgrade & transport	None
Energy savings	Moderate	Moderate	Moderate	Moderate	Moderate
Biogas	42 PJ	42 PJ	42 PJ	42 PJ	-
Waste	42 PJ	42 PJ	42 PJ	42 PJ	-
Biofuel production	Yes	Yes	Yes	Yes	None
Fossil fuels	None	None	None	None	361 PJ

Source: Results from energy analysis for fossil free Denmark by 2050, DEA

Gas is a  
*flexible and  
easily stored  
fuel*

## Biogas production



## Biogas usage

Heat and power

Upgraded to the net

Industry

Transport



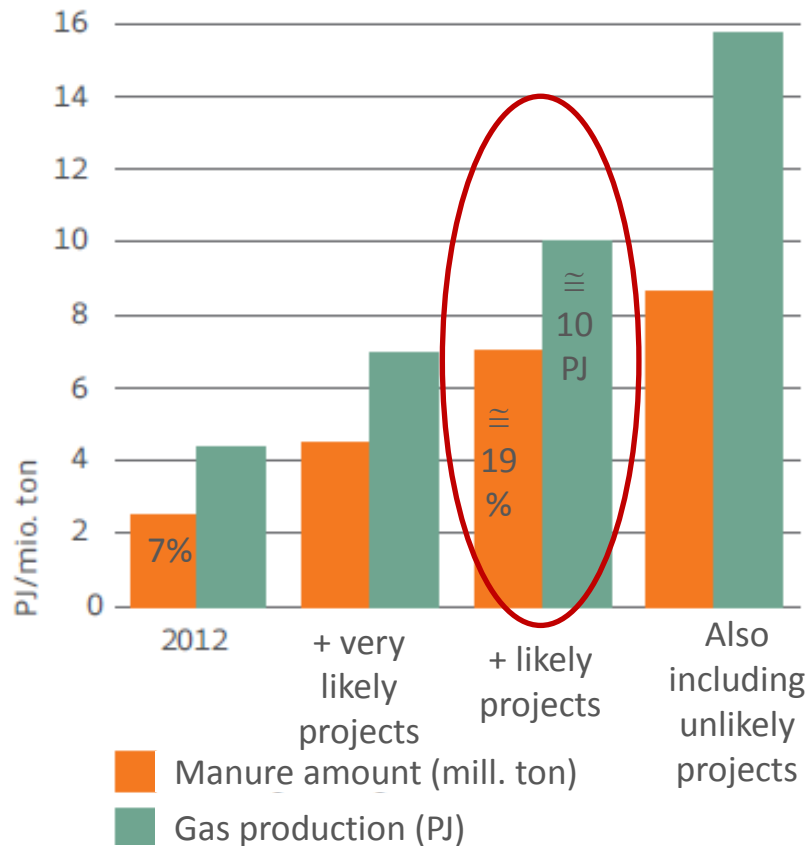
Heat and power

Industry

Transport



# Status and goals for biogas in Denmark



Expectations for 2020 with new regulation.

Source: Results from energy analysis from Biogas Taskforce, DEA

## Targets:

- Around **50%** manure usage
- Around **17PJ by 2020**, and **42PJ by 2050** combined with other technologies

## Expectations for 2020 with new regulation:

- Around 19% manure usage
- Around 10PJ + Biogas

## Current thoughts

- Probably need for more action



# The Joy of anaerobic Biogas

## Environmental benefits

- Emission reductions
- Substitute for fossil fuels

Anaerobic biogas specific

Converted into

Waste

- Renewable Energy
- GHG emission reductions
- Improved fertiliser
- Chance to redistribute nutrients
- Reduced smell

# The Joy of anaerobic Biogas

## Environmental benefits

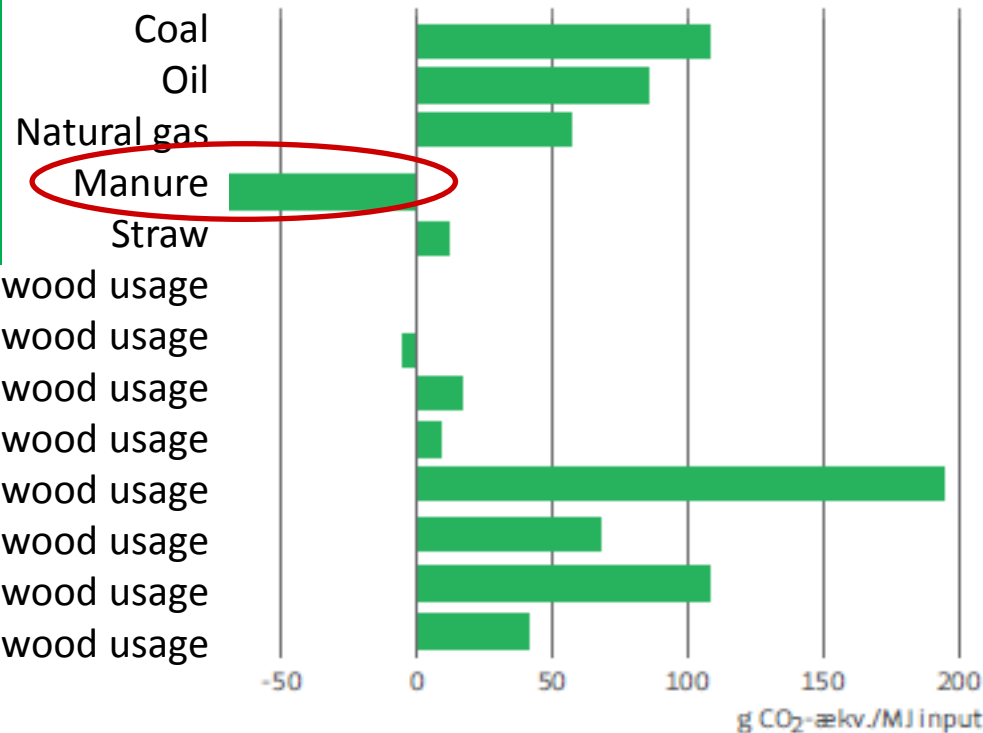
- Emission reductions
- Substitute for fossil fuels

Anaerobic biogas specific

Emissions in CO<sub>2</sub>-equivalents differs between biomass types,

source: Energy analysis, DEA

Various kinds of wood usage  
 Various kinds of wood usage  
 Various kinds of wood usage  
 Various kinds of wood usage  
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 Various kinds of wood usage



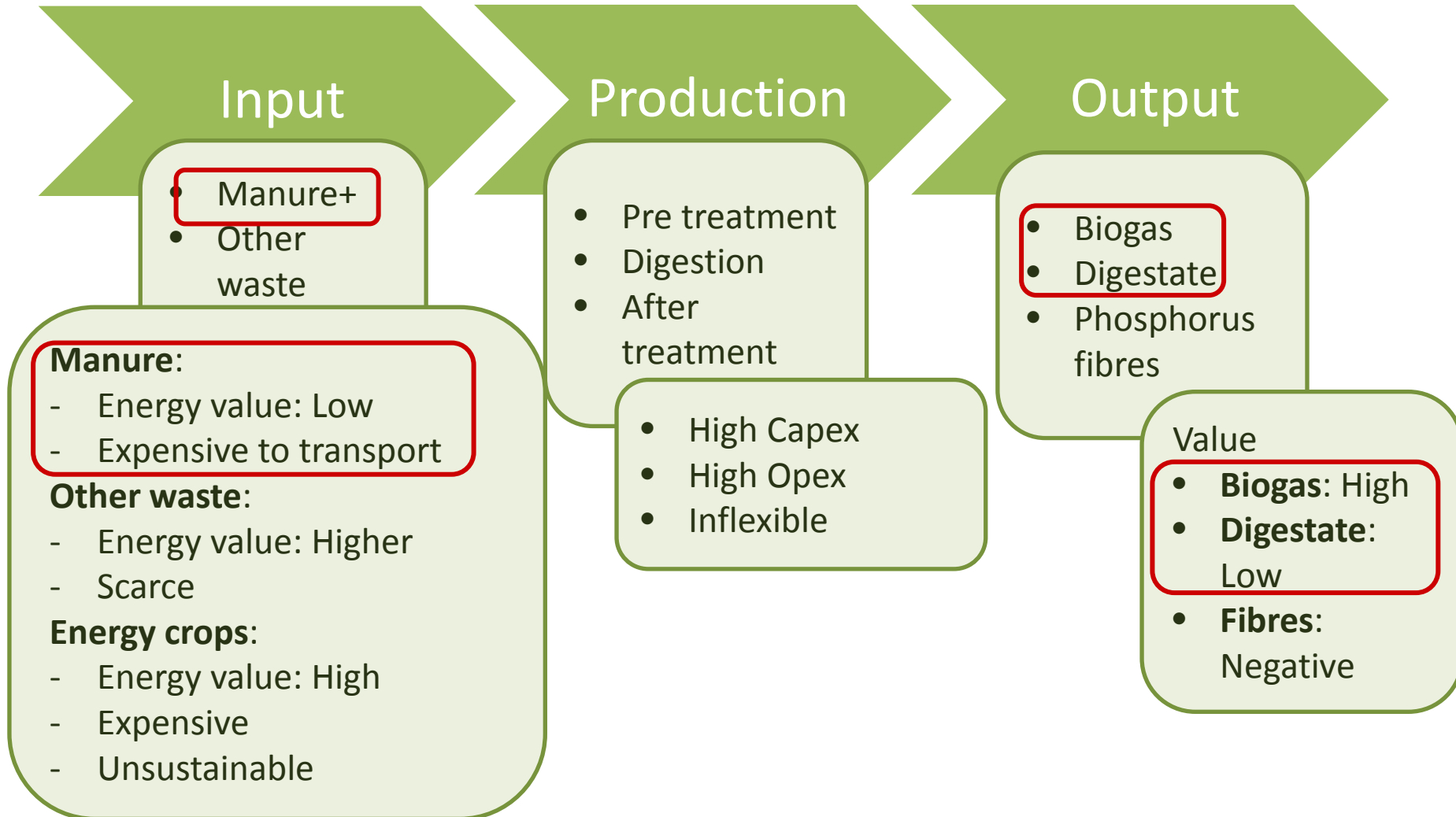
- Renewable

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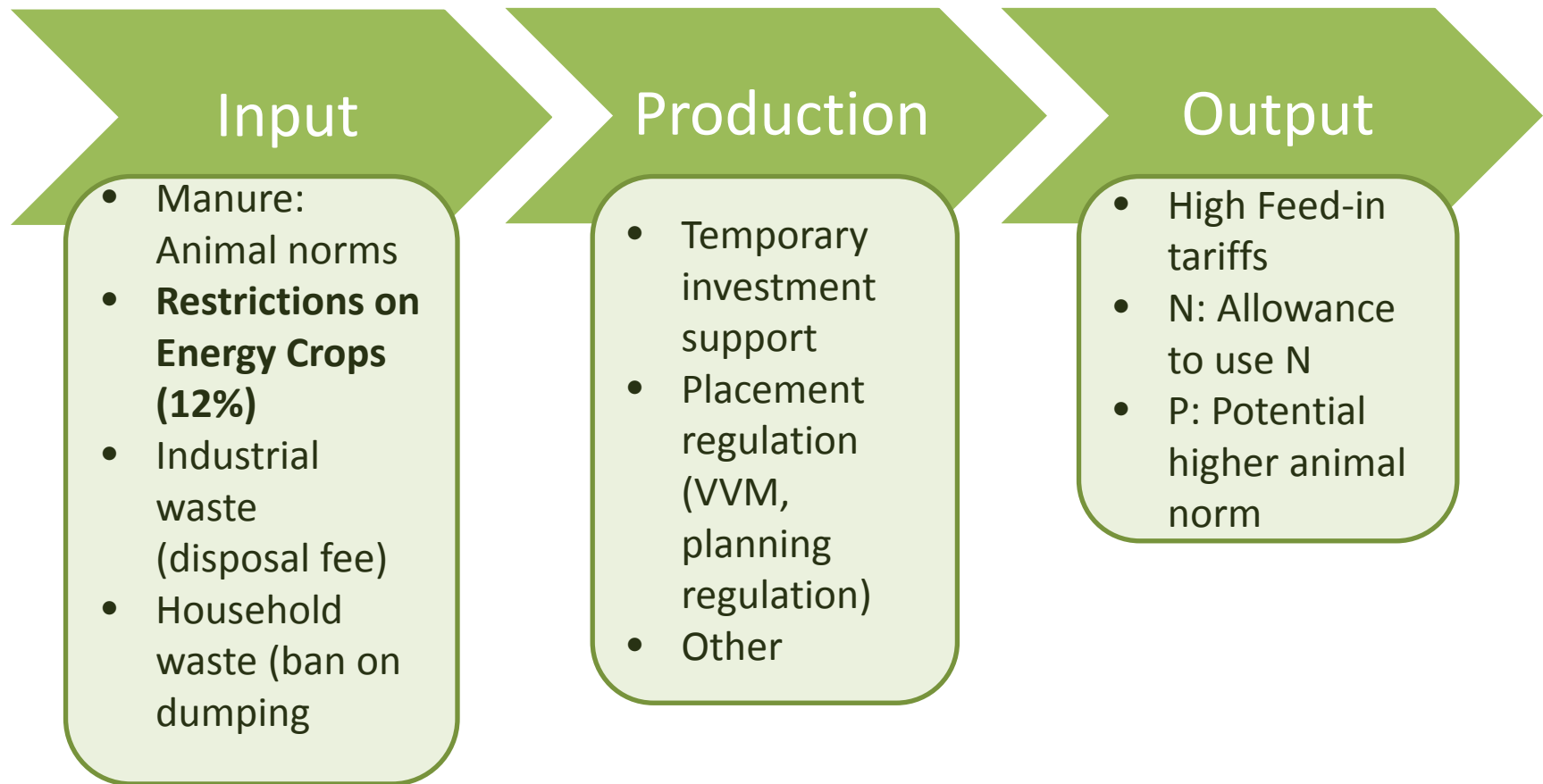
# Biochain: The Biogas Value Chain

- with a private economic focus



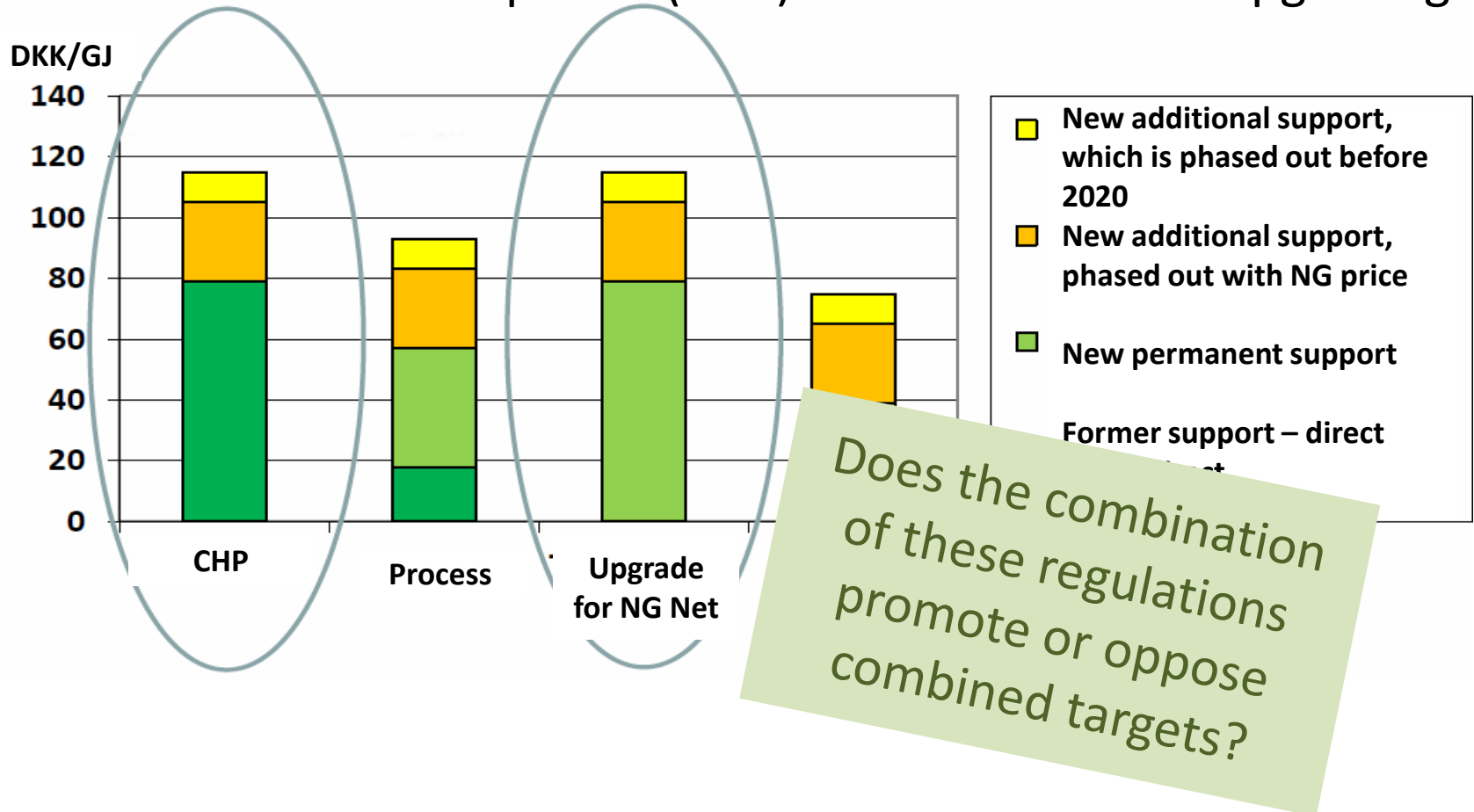


# Related regulation



# Related regulation, changes in support

- High support levels on biogas, particularly on biogas to combined heat- and power (CHP) and NOW also for upgrading



# Economic Value from biogas production

		Market value		Regulative value		Revenue
Product output	Biogas	Natural gas price 47-58 DKK/GJ	+	High Feed-in tariff 115 DKK/GJ	≈	167 DKK/GJ
	Digestate	Higher yield (improved nitrate use) ≈ 5 DKK/ton	+	Higher yield (more allowed nitrate) ≈ 5 DKK/ton	≈	10 DKK/ton
	Phosphorus fibres	Negative price	+	Potentially higher allowed animal norm → high potential saved costs	≈	????
Environmental output	Emission- and smell reduction	Externalities – no price	+	No direct regulation	≈	No direct incentives

Sources: GaspointNordic (<http://www.gaspointnordic.com/market-data>), "Biogas i Danmark – status, barrierer og perspektiver", DEA Danish Energy Agency, (<http://www.ens.dk>)



# First conclusions with current regulation

1. Support and total revenue is almost entirely biogas output dependent
2. The farm level benefits from anaerobic biogas are not assigned much economic value

- I. The additional GHG emissions reductions: No value
- II. Digestate properties: Limited value
- III. As long as phosphorus in mineral fertilisers is cheap  
→ negative or no value

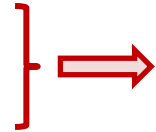


→ Incentives for farmers to join a biogas project are few

# Further is there a regulatory conflict?

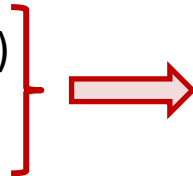
## Support for biogas output

- Production based support incentivise maximum biogas production
  - A focus on inputs with high energy content (biogas potential)
  - Discourages the use of low-value waste inputs as manure



## Secondary regulation to correct for the intended input (manure - agricultural emissions and environmental impact)

- Sustainability restrictions on energy crops as biogas input (max 12% after 2018)
- Investment support granted to projects based on manure and waste water

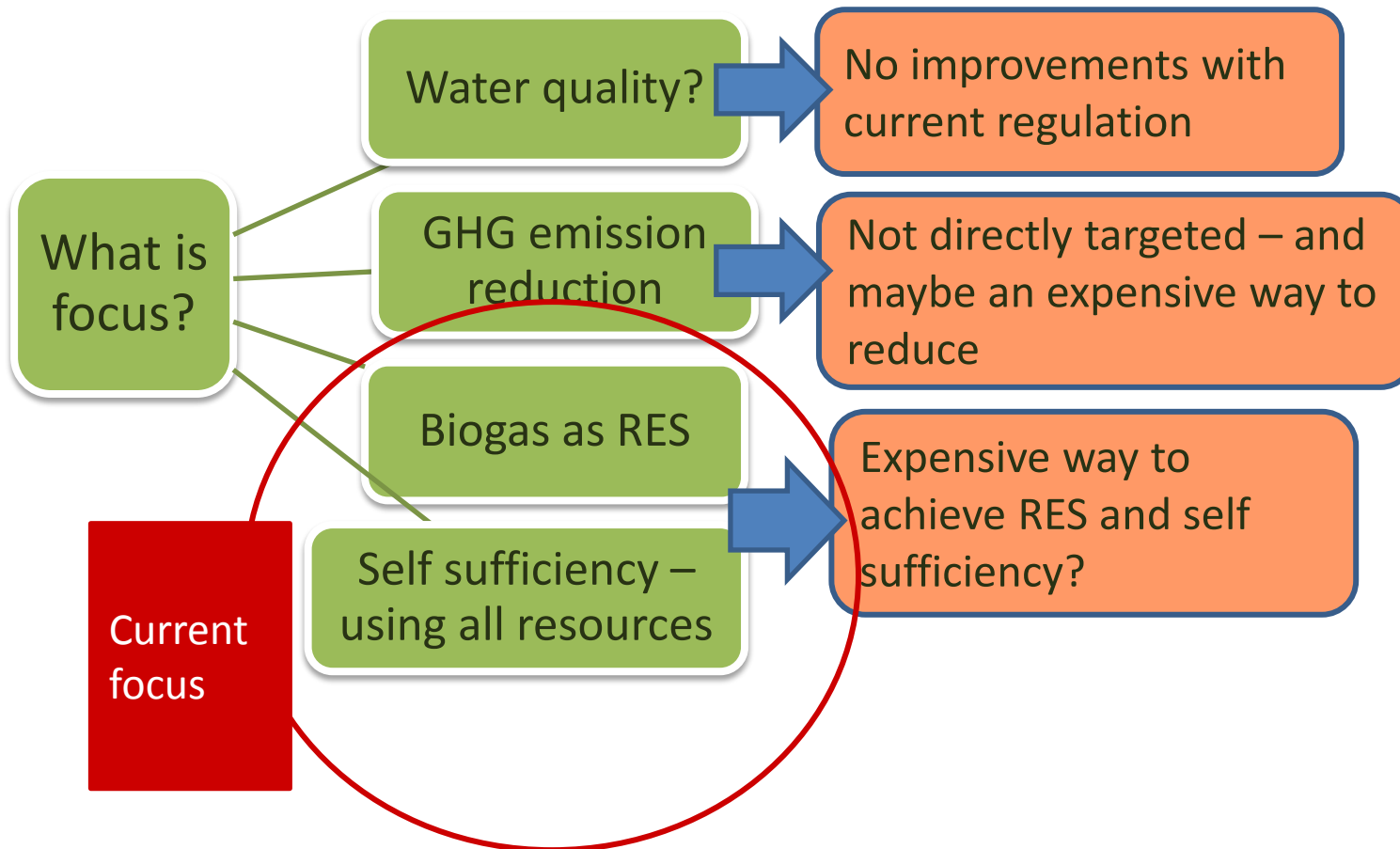


 Secondary regulation works against the primary support 

Leaving biogas plants with incentives to undermine/search for inputs/products that do not fall in the 12% restriction and still qualifies for support → **Risk of higher costs**



# The purpose of current regulation?



# Biogas as Renewable Energy – comparison of support incentives

	Biogas for CHP	Upgraded biogas	Onshore wind	Off-shore wind	Small wind turbines <6 kw	PV	Biomass for power
Fixed price equivalent	116.6 øre/kwh + heat tax exemption	132 øre/kwh	max 58 øre/kwh	106 øre/kwh (Anholt)	150-250 øre/kwh (not in force yet)	60-130 øre/kwh	40 øre/kwh
Premium	80.6 øre/kwh + heat tax exemption	92 øre/kwh	25 øre/kwh				

Support comparisons are illustrated in support equivalent per potential kwh electricity generation: Based on electricity conversion efficiency assumption (45%) and not adjusted for limits on duration of support, Upgraded biogas incurs upgrade costs not accounted for here

## Two stories:

1. Biogas receives a relatively high support → Focus on the cheaper technologies?
  2. Other technologies receives at comparable levels → also political challenged
- Need for good arguments and improved regulation



# Concluding remarks

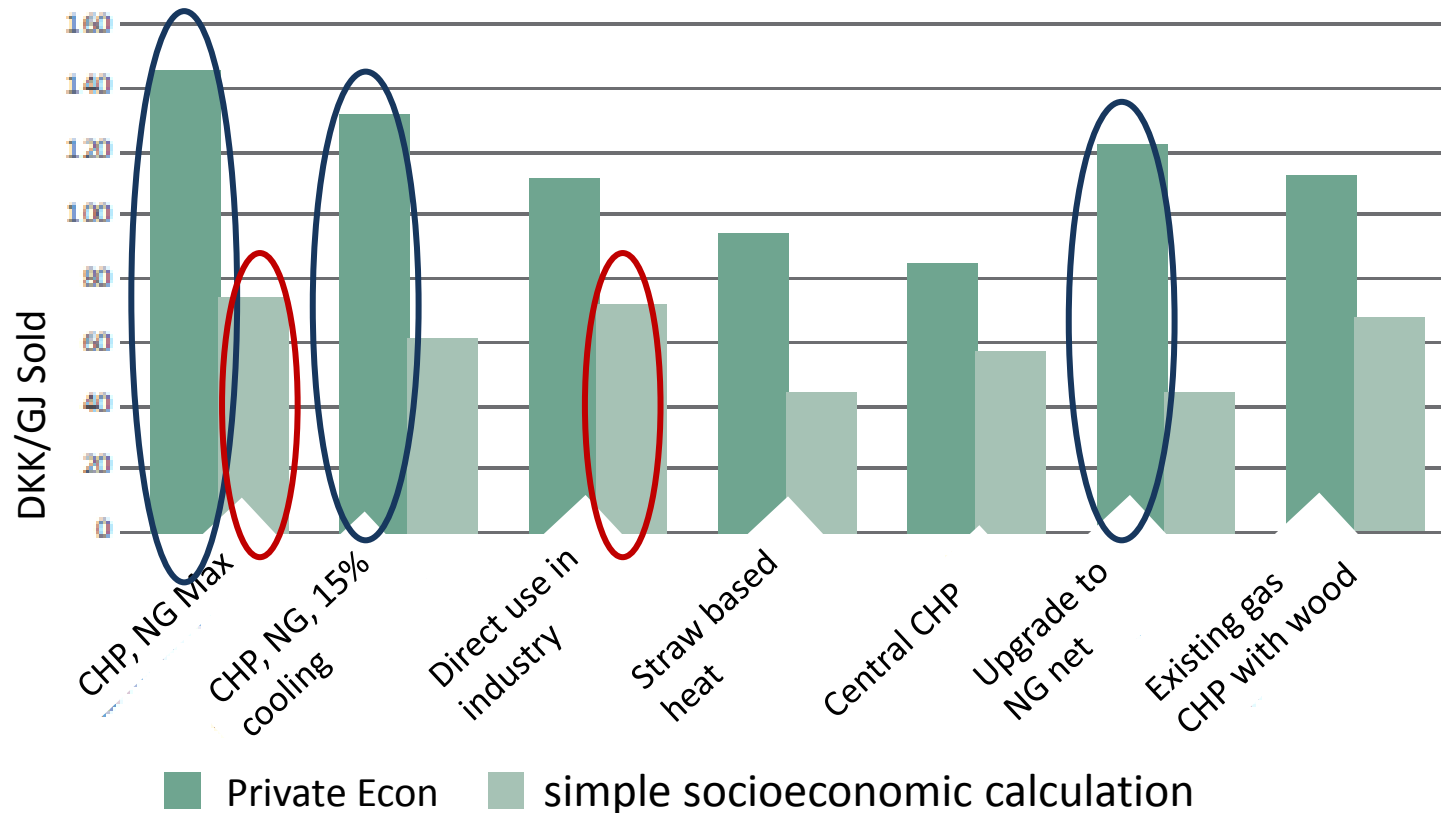
- Biogas in DK is based on manure (agricultural waste) or waste water and comprise both small farm installations and larger facilities
  - Primary objective for regulation is **crowding out fossil fuels** and **secondarily GHG emission reduction** in the agricultural sector
  - Biogas regulation **does not target** water environment and other agricultural environmental issues (Nitrate, Phosphor, smell etc.)
  - And it **does not directly target** GHG emission reductions in agriculture
  - There is a **regulatory conflict** between **promotion of biogas** production and **restrictions on the most productive input** resources
  - Few incentives for farmers to participate
- Regulation is **targeting crowding out fossil fuels**
- but gives **only weak incentives for the GHG emission reduction** in the agricultural sector

## Recommendations for politicians and researchers

- A clear discussion on the actual objective of the regulation
- A clear discussion on willingness to pay
- An investigation of alternative measures in agriculture compared to the high biogas support



# How does biogas fit into the system



Source: Biogas Taskforce, DEA

# How does biogas fit into the system

Hours of Power production at local gas based CHP's



Figur 14. Antallet af driftstimer på gasmotorerne viser en nedadgående tendens pga. faldende elpriser.  
Kilde: Dansk Fjernvarme.

Source: Biogas Taskforce, DEA